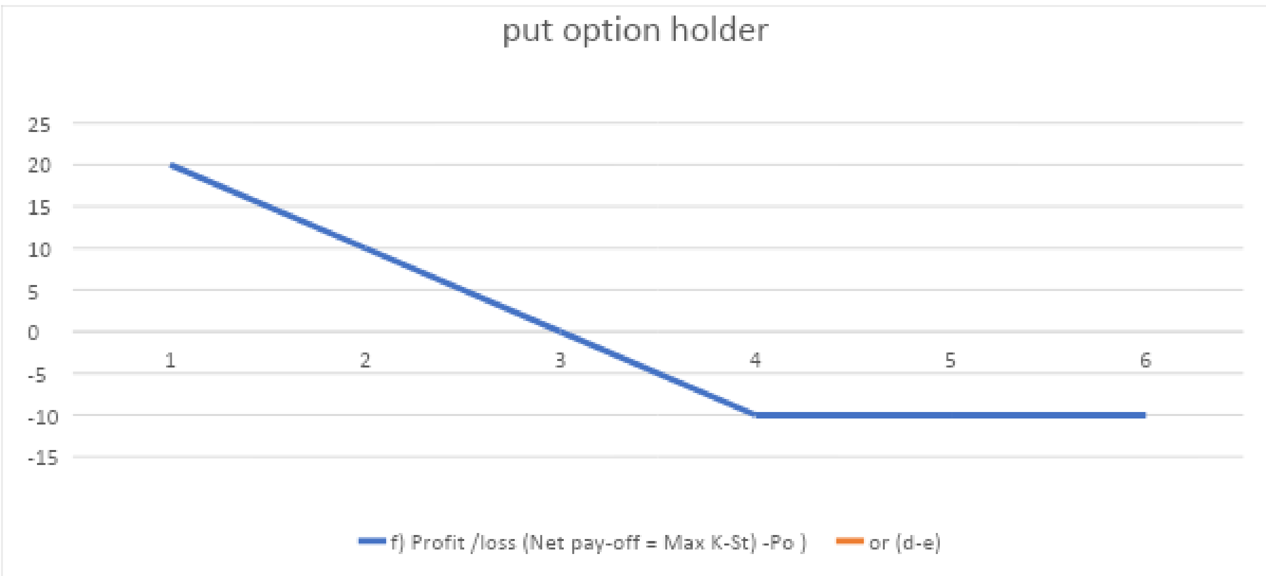
1.Calculate the pay-off of long put from the following data and draw the pay -off diagram

Underlying asset	Reliance stock
Type of option	Put option
Style of option	European
Position	long (Buyer)
Exercise price	Rs 150 Per share
Option Premium	Rs 10 Per Share

Spot Price at expiration say: Rs 120 , Rs 130 , Rs 140 , Rs 150 , Rs 160 , Rs 170 Per share

Sol;

Pay- off of the Put option holder at expiration						
	Rs	Rs	Rs	Rs	Rs	Rs
a) Exercise Price (K)	150	150	150	150	150	150
b) Spot price (S_t)	120	130	140	150	160	170
c) Option Exercise by holder	Yes	Yes	Yes	No	No	No
d) Pay-Off (K -S_t)	30	20	10	-	-	-
e) Put Premium Paid (P_0)	10	10	10	10	10	10
f) Profit /loss (Net pay-off = Max (K-S_t) -P_o) or (d-e)	20	10	0	-10	-10	-10

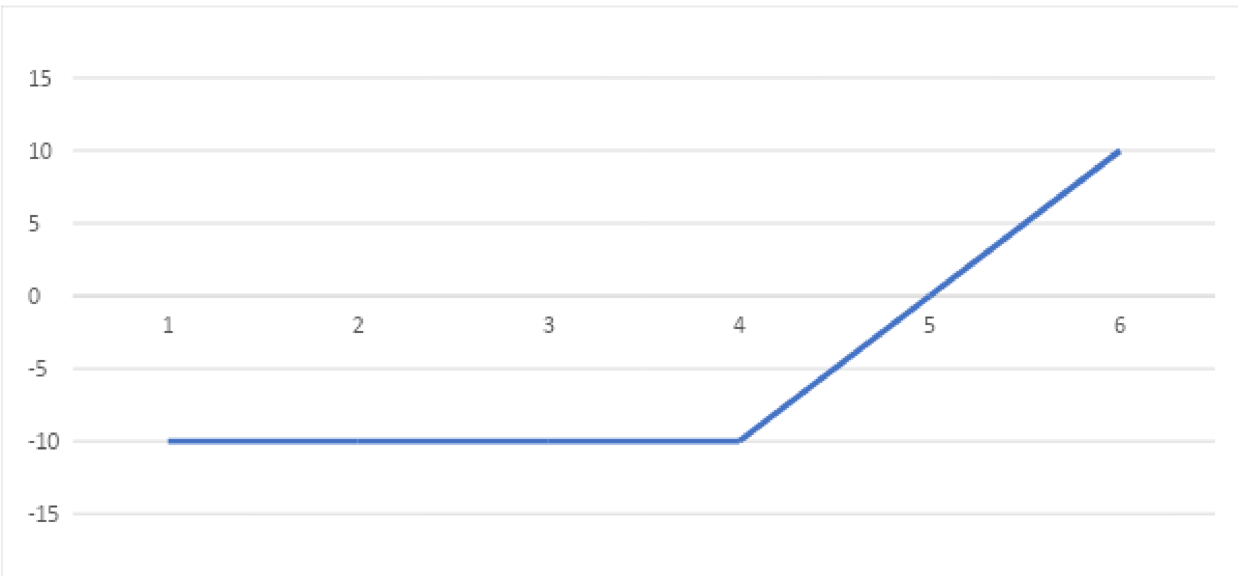


2.Calculate the pay-off of long Call from the following data and draw the pay -off diagram

Underlying asset	Infosys stock
Type of option	Call option
Style of option	European
Position	long (Buyer)
Exercise price	Rs 130 Per share
Option Premium	Rs 10 Per Share

Spot Price at expiration say: Rs 100 , Rs 110 , Rs 120 , Rs 130 , Rs 140 , Rs 150 Per share.

Pay- off of the call option holder at expiration						
	Rs	Rs	Rs	Rs	Rs	Rs
a) Spotprice (S_t)	100	110	120	130	140	150
b) Exercise Price (K)	130	130	130	130	130	130
c) Option Exercise by holder	No	No	No	No	Yes	Yes
d) Pay-Off (S_t - K)	-	-	-	0	10	20
e) Call Premium Paid (C_0)	10	10	10	10	10	10
f) Profit /loss (Net pay-off = max(S_t-K) -C_o) or (d-e)	-10	-10	-10	-10	0	10

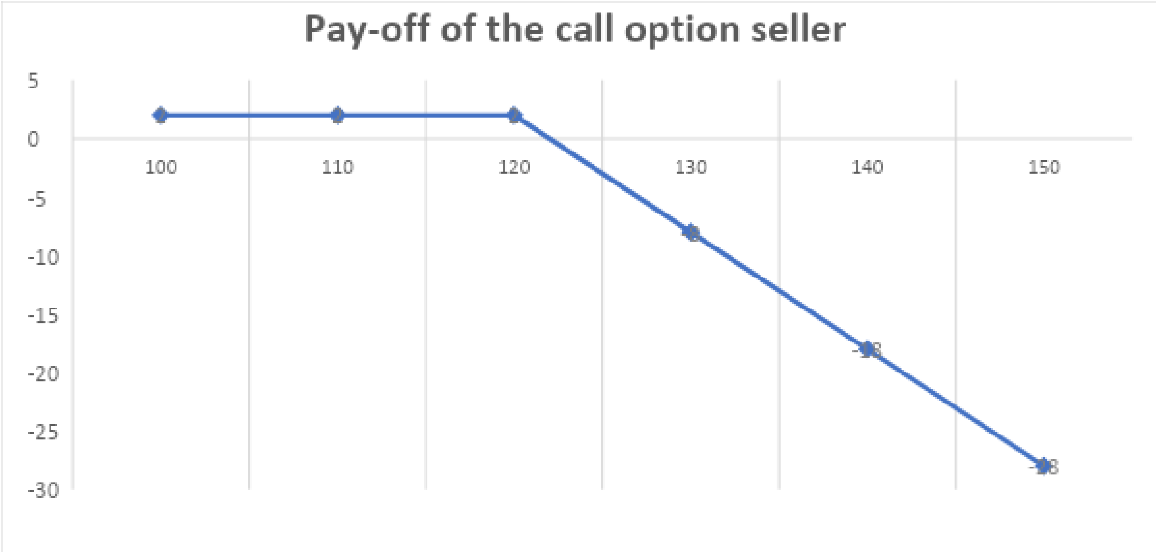


3.Calculate the pay-off of short call from the following data and draw the pay -off diagram

Underlying	Infosys stock
Type of option	Call option
Style of options	European
Position	Short (seller)
Exercise Price	Rs 120
Option Premium	Rs 2 per share

Assume spot price at expiration is Rs 100, Rs 110, Rs 120, Rs 130, Rs 140 , Rs 150 Per share.

Pay- off of the call option writer at expiration						
	Rs	Rs	Rs	Rs	Rs	Rs
a) Exercise Price (K)	120	120	120	120	120	120
b) Spot Price	100	110	120	130	140	150
c) Option Exercise by holder	No	No	No	yes	Yes	Yes
d) Pay-Off = min (k-st,0)	0	0	0	-10	-20	-30
e) Call Premium received	2	2	2	2	2	2
f) Profit /loss (Net pay-off =Co-min (st-k 0) or (d-e)	2	2	2	-8	-18	-28



4.The current market price of a share is Rs 155. the volatility of the share is measured as 20 % the risk-free interest rate is currently 8 % per annum. there is a call option and put option on the share. Time to expiration is 6 months with exercise price Rs 150. calculate put option price using put-call parity of call price is Rs 12.

By using the put-call parity relation model, we have

$P = C - S + Ke^{-rt}$

Where P = Put Price

C = call Price = 12

S = Current Stock Price = Rs 155

K = Exercise price = Rs 150

r = Rate of interest continuously compounded

t = time to expiration = 6 months

now we can calculate =

$P = 12\text{-}155 + 150 \text{ X } e^{(-0.08 \text{ X } 6/12)}$

$P = 12\text{-} 155 + 150 \text{ X } 2.7182^{-0.04}$

$P = 12\text{-}155 + 150 \text{ X } 0.9608$

$P = 12 – 155 + 144.12$

$P = 1.12$

5.Find out put option price from the following data

Current stock price	Rs 160
Strike price	Rs 150
Call option price	18.73
Risk-Free interest rate	8 % p.a
Time to expiration	6 months

Use put -call parity relation formula.

$P = 18.73\text{-}160 + 150 \text{ X } e^{-0.08*0.5}$

$P = 18.73\text{-} 160 + 150 \text{ X } 2.7182^{-0.04}$

$P = 18.73\text{-}160 + 150 \text{ X } 0.9608$

$P = 18.73 – 160 + 144.12$

$P = 2.85$

6.From the following information , calculate call option value and put option value .use black-Scholes model .

S= 280 , K = 260 , r = 8 % p.a , T = 0.6667 , N(d1) = 0.6336 , N(d2) = 0.4470

Sol: Black-scholes model

$C = S_0 \text{ X } N(d1) – Ke^{-rt} \text{ x } N(d2) =$ $280 \text{ X } 0.6336 - 260 \text{ x} 2.7182^{-0.08\text{X}0.667} \text{ X} 0.4470$

$= 177.408 – (260 \times 0.722550734 \times 0.4470)$

$= 177.408 – 110.20$

$= 67.20$

Computation of put option

$P = K e^{-rt} N(-d_2) – S \times N(-d_1) = 260 \times 2.7182^{-0.08X0.667} \times 0.5530) -280 \times 0.3664$

$= 136.33 -102.59 = 33.74$

Working :

$N(-d_1) = 1- N(d_1) = 1-0.6336 = 0.3664$

$N(-d_2) = 1- N(d_2) = 1-0.4470= 0.5530$

7.Companies A and B face the following interest rates (adjusted for the differential impact of taxes):

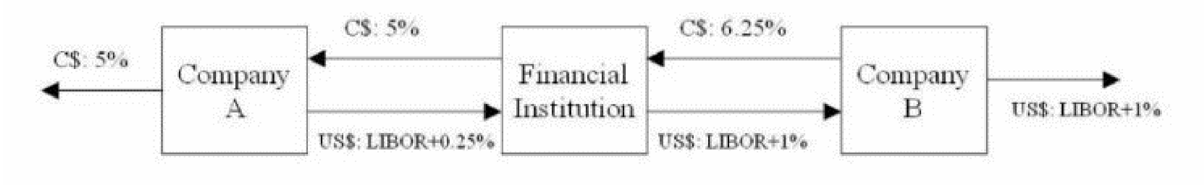
	A	B
US Dollars (floating rate)	LIBOR+0.5 %	LIBOR+1.0 %
Canadian dollars (fixed rate)	5.0%	6.5%

Assume that A wants to borrow U.S. dollars at a floating rate of interest and B wants to borrow Canadian dollars at a fixed rate of interest. A financial institution is planning to arrange a swap and requires a 50-basis-point spread. If the swap is equally attractive to A and B, what rates of interest will A and B end up paying?

Sol:

Company A has a comparative advantage in the Canadian dollar fixed-rate market. Company B has a comparative advantage in the U.S. dollar floating-rate market. (This may be because of their tax positions.) However, company A wants to borrow in the U.S. dollar floating-rate market and company B wants to borrow in the Canadian dollar fixed-rate market. This gives rise to the swap opportunity.

The differential between the U.S. dollar floating rates is 0.5% per annum, and the differential between the Canadian dollar fixed rates is 1.5% per annum. The difference between the differentials is 1% per annum. The total potential gain to all parties from the swap is therefore 1% per annum, or 100 basis points. If the financial intermediary requires 50 basis points, each of A and B can be made 25 basis points better off. Thus a swap can be designed so that it provides A with U.S. dollars at LIBOR 0.25% per annum, and B with Canadian dollars at 6.25% per annum.



OR

Calculate the effective rate of interest

Total interest rate without swap

ABC (floating rate) = LIBOR + 0.5%

XYZ (Fixed rate) = 6.5 %

\- ------------------------

A= LIBOR + 7 %

Total interest rate with swap

ABC (Fixed rate) = 5 %

XYZ (Floating rate) = LIBOR + 1 %

B= LIBOR + 6 %

Gain (A- B) = LIBOR +7 %

LIBOR +6 %

=1 % (Here 1 % is equal to 100 bps)

Less Financial intermediary = 0.5 % (50 financial intermediary requires 50 basis points

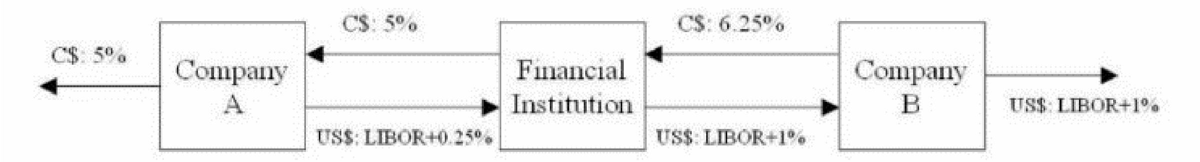
Net gain = 0.5% (this 1 % distributed to ABC and XYZ) i.e

= ABC = 0.25 % ; XYZ = 0.25 %

Effective rate of interest = Desire borrowings-share in net gain

ABC =LIBOR +0.5% - 0.25 % = LIBOR+0.25%

XYZ = 6.5 % -0.25 = 6.25



8. ABC ltd Wishes to borrow 10,00,000 for one year .it can borrow @8 % fixed or LIBOR + 1 % floating rate. there is another company XYZ Ltd. which also requires the same amount, but the lower credit rating can borrow either @12 % fixed or LIBOR + 3 % floating. However, because of existing debt portfolio, ABC wants to borrow at floating rate and XYZ Ltd , wants to borrow at fixed rate of interest. A financial institution is planning to arrange a swap and requires a 1% commission spread. If the swap is equally attractive to ABC and XYZ, what is the effective rate of interest will ABC and XYZ end up paying?

Calculate the effective rate of interest

Total interest rate without swap

ABC (floating rate) = LIBOR + 1%

XYZ (Fixed rate) = 12 %

- -----------------------

A= LIBOR + 13 %

Total interest rate with swap

ABC (Fixed rate) = 8 %

XYZ (Floating rate) = LIBOR + 3 %

B= LIBOR + 11 %

Gain (A- B) = LIBOR +13 %

-LIBOR +11 %

=2 %

Less Bank commission = 1 %

Net gain = 1 %

(this 1 % distributed to ABC and XYZ) i.e = ABC = 0.5 % ; XYZ = 0.5 %

Effective rate of interest = Desire borrowings-share in net gain

ABC =LIBOR +1% - 0.5 % = LIBOR+0.5%

XYZ = 12 % -0.5 = 11.5 %

9.Consider a three-month futures contract on a particular stock Index. Further assume that the stock Index provides a dividend yield of 3% p.a the current value of the stock index is Rs 900 and the continuously compounded risk-free interest rate is 8% p.a determine future price of Index.

Given that,

Spot price of Index =s=900

Dividend yield y=0.03

Risk free rate r= 8%=0.08

Contract duration T=3 months

Future price of Index $F=Se^{(r-y)T}$

$F=900*e^{(0.08-0.03)3/12}$

$=900*e^{0.05*0.25}$

$=900*e^{0.0125}$

=900*1.0126

=911.321

10.From the following data, Calculate the value of the Call option under Black -Scholes model

Current market price	Rs 165.
Exercise price	Rs 150.
Risk free rate	6 % p.a
Period	2 years
Standard deviation	15%

Call option:-

Put option:-

Here

Illustration 7

Calculate the value of a call option from the following data by using Black-Scholes option pricing formula:

$S = 100$ $\quad\quad X = 100$

$r = 0.05$ $\quad\quad \sigma = 0.10$

$T = 90$ days $= 0.25$ years

Solution:

$C = S\ N(d_1) - X\ e^{-rT}\ N(d_2)$

Where

$$d_1 = \frac{l_n(S/X) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

$$= \frac{l_n\left(\frac{100}{100}\right) + \left\{0.05 + \frac{0.10^2}{2}\right\}T}{0.10 \times \sqrt{0.25}}$$

$$= \frac{l_n 1 + (0.05 \times 0.005 \times 0.25)}{0.10 \times 0.5} = \frac{0 + 0.01375}{0.05} = 0.275$$

Then $d_2 = d_1 - \sigma\sqrt{T} = -0.275 - 0.1 \times \sqrt{0.25} = 0.225$

Now we have to calculate the cumulative normal probability values of d_1 and d_2. These values can be identified from the cumulative Normal Distribution Table:

$N(d_1) = N(0.275) = 0.6084$

$N(d_2) = N(0.225) = 0.5891$

In the final step, we have to compute the call option value by using BSOPM formula.

$C = S\ N(d_1) - X\ e^{-rT}\ N(d_2)$

$= 100 \times 0.6084 - 100\ e^{-0.05 \times 0.25} \times 0.5891$

$= 60.84 - (100 \times 0.98759 \times 0.5891) = 60.84 - 58.18 = 2.66$

Illustration 8

Take all the data in example 7 and calculate put option price by using Black-Scholes formula and test the result with put-call parity.

Solution:

(a) Put Value: $P = X\,e^{-rT}\,N(-d_2) - SN\,(-d_1)$

Step 1. Computation of values of $N(-d_2)$ and $N\,(-d_1)$

$N\,(-d_2) \quad = 1 - N\,(d_2) = 1 - 0.5891 = 0.4109$

$N\,(-d_1) \quad = 1 - N\,(d_1) = 1 - 0.6084 = 0.3916$

By putting these values in the formula, we get the put option value as:

$P \quad = \{100\,e^{-0.05 \times 0.25} \times 0.4109\} - \{100 \times 0.3916\}$

$= (100 \times 0.98759 \times 0.4109) - 39.16$

$= 40.58 - 39.16 = 1.42$

(b) Put-Call Parity

$P \quad = C - S + X\,e^{-rT}$

$P \quad = 2.66 - 100 + 100 \times 0.98759$

$= 2.66 - 100 + 98.76$

$= 101.42 - 100 = 1.42$

11. Find the value of a one-year option from the following data

Type of option	Call Option
Style of Option	European
Current Stock Price	Rs 150
Exercise Price	Rs 160
Up factor	20%
Down Factor	10%
Risk free interest rate	9 %

Use Replicating Portfolio strategy of Binominal Model.

12. Suppose a one-year future contract on gold with a storage cost if Rs.20 per 10 gm per year to store gold to be paid at the end of the year. Assume that the spot price 4500 and risk-free interest rate is 7% per annum.

Sol:

U= 20 = 20 x e^{-rt} = 20 X $2.7182^{-0.07*1}$ = 18.64792

F=(S+u)e^rT

=(4500+18.65)x$2.7182^{0.07*1}$

= 4518.65 X $2.7182^{0.07*1}$

=4846.278881

12.Find the value of a one-year option from the following data

Type of option	Call option
Style of option	European
Current Stock Price	Rs 150
Exercise Price	Rs160
Up factor	20 %
Down factor	10 %
Option Period	one year
Risk free interest rate	9 % p.a

Use Replicating Portfolio strategy of Binominal Model

13. From the following information, calculate call option value and put option value

Current market price (S)	Rs 100 Per share
Exercise price (K)	Rs 80 Per share
Volatility of share price	30 %
Risk- free interest rate	10 % p.a
Time to expiration (T)	3 Months

Use Black -Scholes formula .

14. The stocks underlying an index provide a dividend yield of 4% per annum, the current value of the index is 520 and that the continuously compounded risk-free rate of interest is 10% per annum. Find the value of a 3-month forward contract.

15. A forward contract on a non-dividend paying share which is available at Rs 70, to mature in 3 months' time. If the risk-free rate of interest be 8% per annum compounded continuously, find the price of the contract.

16. Calculate the pay-off of Short Call from the following data and draw the pay -off diagram

Underlying asset	Infosys stock
Type of option	Call option
Style of option	European
Position	Short (Seller)
Exercise price	Rs 150 Per share
Option Premium	Rs 5 Per Share

Spot Price at expiration say: Rs 130 , Rs 140 , Rs 150 , Rs 160 , Rs 170 , Rs 180 Per share

17. Calculate lower bound from the following data

Stock Price	Rs 270
Style option	European
Type of option	Call
Strike Price	Rs 265 Per share
Interest rate	10 % p.a
Interest rate	6 months
Dividend	NIL

a lower bound for the price of a European call option on a non-dividend paying is calculated formula = $S - Ke^{-rt}$

$$= 270 - 265 \text{ x} 2.7182^{-0.10*0.5}$$

$$= 270 - 265 * 0.9512$$

$$= 270 - 252$$

$$= 18$$

From the following data

Current price of the stock	Rs 100
Option period	3 months
Up movement factor (u)	1.1
Down movement factor (d)	0.9
Exercise Price	Rs 105
Risk free interest rate	12% p.a
Type of option	European call